MORE FOOD

THROUGH CONSERVATION FARMING

FOOD FOR MEN AT WAR

FOOD FOR MEN AT WORK

FOOD FOR OUR ALLIES

U. S. Department of Agriculture

Farmers' Bulletin 1909

TOTAL WAR REQUIRES total production. Every acre of farm and range land must do its part in meeting the demands for food, fiber, and oil crops—not merely for this year, but for several years—no one can predict how long.

Conservation methods of farming, based as they are on efficient utilization of soil and water, are contributing greatly to meeting the goals of production *now* and over the long haul. Farmers can obtain larger total output during the next several years by following the principles of effective use of the land.

Conservation farming is the guarantee that production will be obtained and that it will continue. And conservation farming is the guarantee that in winning the war America will not lose the agricultural productive capacity that has helped give it supremacy among nations.

This bulletin discusses in general the ways in which conservation measures increase crop production, improve pasture and range, and maintain the productivity of the soil.

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MORE FOOD THROUGH CONSERVATION FARMING

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AGRICULTURE'S PART IN THE WAR

TODAY WE ARE faced with the gravest problem of food production since the Revolutionary War. Food requirements are increasing month by month. As our armed forces grow in size, the demand for food increases correspondingly. A fighting man eats much more every day than a civilian (fig. 1). But our civilians want to eat well too, and now they have the money to buy the food they want—if it is available on the grocer's shelves and in the meat markets. So the civilian demand has grown to great proportions. And then there is lend-lease. Considerable quantities of food are being sent to our allies on the battle fronts of the world.

Farmers face monumental handicaps in their food production job. There is a shortage of farm labor, especially experienced farm labor. There are limitations on gasoline, on tires, on fertilizer, on machinery, and on other kinds of production, processing, and distribution equipment. These shortages and limitations will have to be met if we are to carry through our wartime food production responsibilities.

Nearly all of the 6 million farmers of the United States have enlisted in a program of production to meet war needs and to prepare for building a lasting peace. Never before has a nation undertaken such a vast program of increased agricultural output.

And while American farmers are redoubling their efforts to raise more this year, they are preparing for a long war. They must keep up production next year, and the year after that—no one knows how long. Even after the fighting stops, large supplies of farm products from this country will be needed to feed starving peoples in many parts of the world. American food will help insure a just and lasting peace.

The United States has a great potential market for farm products among its own people. Ways of developing this vast market were being found when war struck. After the war is over the home market for farm produce may be greater than ever before.

WAR PRODUCTION GOALS

Compared with the task that faces American agriculture today, the job that the farmer did in 1917–19 was easy. In that war we could just plow up more land. Today we need every acre of pasture and range, every acre of hay land. The homestead lands are gone. Most of the plowable forest land is in cultivation already.

During the first World War, farmers were asked to produce more wheat, more corn, more cotton. Today they are being asked to produce more milk, more meat, more vegetables, more poultry products, more soybeans, more peanuts—more of almost every important commodity that comes from the farm.

A greatly increased production of cover-crop seed is also needed in order that farmers may offset the shortage of nitrogen fertilizer and protect, with cover crops, the additional acreage going into clean-tilled crops (fig. 2). Every farm garden that supplies food to the

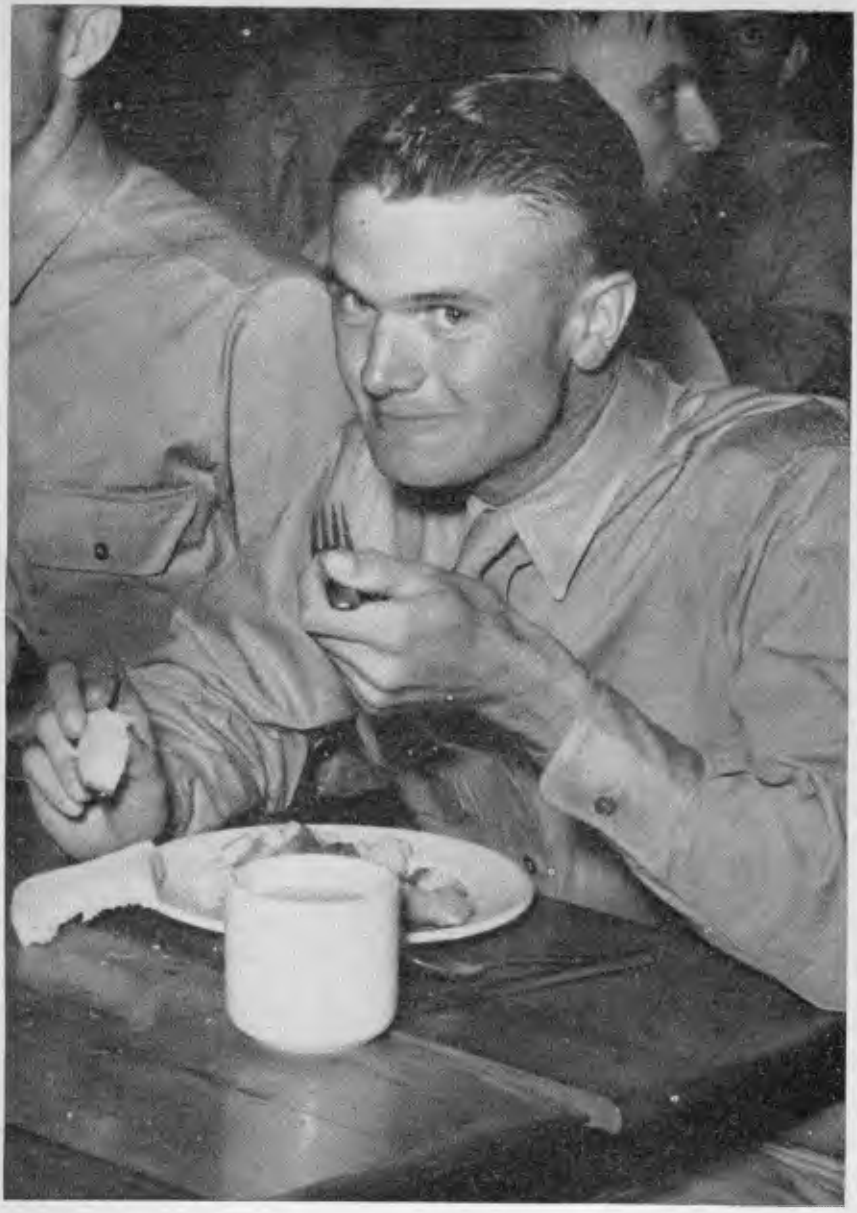


PHOTO BY U. S. ARMY SIGNAL CORPS

FIGURE 1.—A fighting man has to eat much more than a civilian, and food requirements for the Army are increasing every month.

GA.-D3-48

FIGURE 2.—Crotalaria is one of the cover crops southern farmers will be using more and more. This crop, on a farm near Gainesville, Ga., produced effective summer cover and a large crop of seed. Enough seed was left after harvesting for a thick volunteer stand following the next row crop.

TEX-835

FIGURE 3.—Farm gardens will help supply food needs and reduce the cost of farm living. A windmill supplies water to irrigate a garden including grapevines, and fruit trees on a dry-land farm in Texas.

farm family aids the war effort by releasing more food to our fighting forces (fig. 3).

HOW AND WHERE TO INCREASE CROPS

The results of an indiscriminate plow-up, as we learned during the period of the last war, are monstrous duststorms, gullies, abandoned farms, relief programs, and farm migration.

Plowing up land right and left would be the expedient way, and the frightened way to seek more production. It would not be the wise way and it would bring only a relatively small increase in the total food supply. Further, only a fool would gamble that the increase could be maintained, because land unsuited for plowing gives way fast to duststorms and gullies.

We have a better way to increase production. That is the conservation way. We know where the good land is and we know the conservation farming methods that will increase per-acre production. And it should be emphasized that increased production resulting from conservation-farming methods is accomplished with just about the same amounts of labor, equipment, and production materials that are used in other types of farming operations.

We must use our land for the kinds of crops that it can best produce and in the way that it can produce them best. Conservation practices that control erosion and improve production will give the farmers best results (fig. 4).

Frequently, severely eroded land that is being cultivated at a loss can be converted to pasture or woodland, thereby increasing production and eliminating the waste of labor. Areas of moist lowland that are now growing up in brush can be cleared and developed into excellent pasture, or may be drained and cultivated. Eroded and abandoned slopes that are covered with weeds may be converted into valuable forage-producing land by fertilizing and planting them to the right kinds of legumes and grasses. Forage produced on this land will increase the amount of feed available for livestock and will also allow more of the legumes grown in crop rotations to be left on the land for erosion control and soil improvement. Areas of land that are not suited for the production of forage or grazing crops should be planted to trees or protected from fire and grazing, to permit them to produce wood crops and shelter for fur-bearing animals or game (fig. 5).

Using land in accordance with its needs and capabilities requires, as a general principle, that crops should be grown to fit the conditions of soil, slope, and erodibility of the land, and that the livestock kept should be adapted to the crops. The land use and soil-conserving measures that are put into practice may be modified or controlled by other factors, such as the farmer's means, the size of the farm, and so on; but the foundation plans must be developed in accordance with such physical conditions as the kind of soil, the degree of slope, the character and extent of erosion, and climatic conditions (fig. 6).

There are two major groups of the uses to which land can be put in order to maintain its productivity and protect it from erosion.

One group covers the lands that are suitable for cultivation and includes both level and sloping land. The other group covers lands that are too poorly drained, too infertile, too stony, too shallow, or too dry for cultivated crops. Such lands usually can be used for grazing or forest production. A small proportion may be wasteland, usually in exceedingly arid or rough country, and is useful mainly for wildlife and recreation.

The first call on agriculture in wartime is for more intensive use of the smoother land which can be cultivated safely and permanently

N. D.-405

FIGURE 4.—Conservation practices and hard work turned wasteland into productive cropland on this farm. Alfred Riskedahl, the farmer, cooperates with the Kidder County Soil Conservation District in North Dakota.

without special practices to keep the soil from washing. Tillage, year after year, will reduce the organic-matter content, change the soil structure, and thus eventually reduce yields, but in the present emergency it is necessary to use some of the stored-up fertility of such land. Since little soil is lost through erosion on these level lands, the organic matter may be restored at a later date. But this kind of land is scarce; many farms have none.

INCREASING PRODUCTION ON SLOPING CROPLAND

On the sloping cropland, where there are varying degrees of danger from erosion, crop production can be increased much more effectively and economically by using soil-building and soil-conserving practices than by plowing and planting more acres that are unsuited to cultivation. The chief practices needed on sloping cropland are crop rotations, fertilizing, contour tillage, strip cropping, cover cropping, the use of crop residues for mulch, and terracing. Such practices are necessary to keep the topsoil, which is richest in plant food, from being washed or blown away and to give the plants a good supply of moisture

W. VA.–363

FIGURE 5.—A good natural stand of young Virginia pine being cleared from an abandoned hillside field. Land like this is worth more in trees than it is in crops or pasture. Clearing such land probably will mean a loss, rather than a gain, in total production over a period of several years.

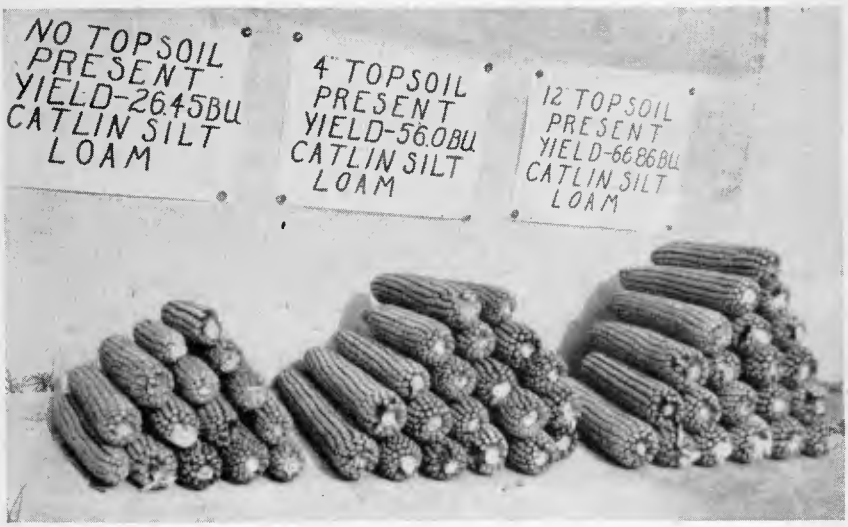
WN.–55017

FIGURE 6.—Sweetclover in alternate 7-inch drill rows with spring barley, near Davenport, in eastern Washington. This method of seeding helps to get a stand under dry conditions, where it is impossible to get a stand by seeding the clover in each drill row with the small grain.

467064°—42——2

for making use of the plant food that is in the topsoil (fig. 7). One rain on a poorly protected field may wash away more plant food than would be used to grow a crop (fig. 8).

On some farms, permanent grassland least subject to erosion may be plowed up to increase the acreage of clean-tilled crops. Wherever this is done, a corresponding acreage of the least fertile land, which is most subject to erosion, should be seeded to grass for hay or pasture in order to maintain or establish a rotation of crops that will assure maximum production.



ILL.-1375

FIGURE 7.—The effects of depth of topsoil on corn yields. On fields near Edwardsville, Ill., corn yielded 67 bushels per acre where the topsoil was 12 inches deep, 56 bushels where it was 4 inches deep, and 26 bushels where all the topsoil had been washed away.

CONTOUR CULTIVATION AND STRIP CROPPING INCREASE YIELDS

By plowing, harrowing, planting, cultivating, and harvesting on the contour (driving on the level rather than up and down slopes), the movement of water off the field is slowed down and more water soaks into the ground. With less water running off and running off more slowly much less soil is carried down the slope and out of the fields. Narrow contour strips of soil-protecting crops between strips of crops that provide little protection, help to reduce losses of soil, water, and seed, and may also protect the soil from the wind (figs. 9 and 10).

It is very important that strips follow the contour very closely—within 2 or 3 percent—and that grass or other erosion-controlling vegetation be grown in all depressions where runoff water might concentrate. Otherwise serious washing and gullying may result.

On farms where large acreages of roughage are grown, row crops and small grain should be grown in alternate contour strips with

meadow. By growing alternate strips of corn and meadow, and of small grain and meadow, in separate fields, the small-grain stubble can be grazed after harvest. Strips of row crops alternating with small grain and small grain alternating with summer fallow are helpful in controlling wind erosion.

Less fuel, less power, and less work are required to farm on the contour than to farm in straight rows up and down hill. Contour cultivation means greater production and less danger of crop failure. In western New York a survey of 583 farms showed that the average length of all rows was one-fourth greater where contour cultivation was practiced. In central New York, four crops of potatoes planted on the contour averaged 166 bushels per acre, or 14 percent more than potatoes planted in straight rows running up and down hill.

Contour listing of corn in southwest Iowa increased the yield from 18 bushels to 30 bushels per acre, or 67 percent during the 6-year period 1933 to 1938, which included 3 dry years. During this period, chinch bug and grasshopper injury was severe. While a lack of moisture limits the yield of corn to a lesser extent in the eastern part than in the western part of the Corn Belt, many observations seem to justify an estimate of 10-percent increase in corn yield per acre, due to contour cultivation in a large proportion of the Corn Belt where erosion is a factor.

In the semiarid Southwest, contour cultivation and level terraces have increased yields of beans from 165 pounds to 243 pounds per acre (fig. 11). In the western part of the Cotton Belt, terracing has increased lint cotton yields as much as 62 percent, or from 109 to 177 pounds per acre. In one locality contour cultivation alone resulted in 27 percent greater yields of grain sorghums; while terracing in addition to contour cultivation, increased yields to 723 pounds per acre, or 57 percent more than was obtained where neither terracing nor contour cultivation was practiced. Similar results have been obtained with corn, wheat, and other crops (fig. 12). Under average weather conditions similar results may be expected in many parts of the Southwest.

On gently sloping land with a good sod, contour strip cropping can readily be established by breaking the land on the contour and leaving alternate strips unbroken. After a year in some row crop and a year in small grain, the plowed strips should go back to grass, and the alternate sod strips may be broken to raise crops for a couple of years. The year that the field is in row crops, the grass strips may be cut for hay. The next year, when the field is in grain, it may be pastured as soon as the small grain is harvested.

Regardless of the pattern of cropping, all drainage or waterways should be left with wide strips of grass. Of course, this will require lifting the plow many times and will reduce the acreage for crops, but it will protect the field from gullies and provide outlets in case terraces need to be put in. And then, such waterways produce hay needed for livestock as well as pasture, after the crops are harvested.

Where erosion is more likely, as on longer slopes, steeper slopes, or poorer soil, contour cultivation and strip cropping must be supplemented with other measures. Terraces, greater use of grass in longer rotations, and greater care in all handling of soil, crops, and crop residues will curb washing on all but the steepest croplands.

CAL.-424

FIGURE 8.—Severe sheet erosion on a comparatively level clean-cultivated bean-field, in Orange County, Calif. The slope is gentle, about 2 feet in 100 feet. Basin listing, broad-base terracing, contour subsoiling, and winter cover crops have proved successful in preventing crop damage, controlling erosion, and conserving water on similar slopes of this area.

WYO.-406

FIGURE 9.—Alternate strips of corn and wheat on the contour reduce wind damage to crops and soil. Most important on land like this, where water is the limiting factor in yields, contour strips save practically all runoff. On this ranch, near Gillette, Wyo., wheat made 40 bushels per acre on 50 acres which had been summer-fallowed on the contour.

TENN.–10014

FIGURE 10.—Tobacco on the contour. Charles Bidwell, of Davidson County, Tenn., has farmed on the contour for 30 years, using a rotation of 1 year of tobacco followed by winter small grain and 3 years of meadow consisting of redtop and lespedeza. He has a reputation for raising tobacco of high quality.

COLO.–1041

FIGURE 11.—Contour cultivation on a dry-land farm in the Glade Park Soil Conservation District in western Colorado. Production on this beanfield was stepped up after contour cultivation helped retain moisture that previously had been wasted.

NEBR.-1170; NEBR.-1171

FIGURE 12.—Nebraska farmers exhibit proof that contour farming helps increase production from the land. *A*, Hypolt Elson and his son, near Columbus, show the difference between corn yields on straight-row and contoured fields in 1940. *B*, Nick Claussen, near Stanton, shows the same thing. In both instances, the contoured corn outyielded the straight-row corn by about 50 percent.

TERRACES CONTRIBUTE TO THE MAINTENANCE OF CROP YIELDS

Terracing is a valuable means of preventing water erosion and conserving moisture. In regions of heavy rainfall, terraces break up long slopes and drain off surplus waters gently but quickly. In dry-farming sections, such as the Great Plains, level terraces that follow the contour help retain most of the rainfall on the field and conserve water for increased crop production (fig. 13).

TEX.-17685

FIGURE 13.—A terrace (far left) and contour rows holding water 23 hours after a 4-inch rain in Lamb County, Tex., May 25, 1937. By running rows parallel to terraces, a much more even distribution of the water is accomplished.

Terracing is useful mainly on sloping lands that must be used for crops and on which less expensive measures will not provide adequate erosion control or moisture conservation. Terracing will not take the place of permanent plant cover on land that is not suited for cultivation, although it may be advisable for moisture conservation, for gully control, or as an aid in establishing permanent vegetation. The cost of terracing is not justified on lands that can be adequately protected by proper tillage and other measures such as crop rotations and strip cropping.

Terraces should always be supplemented with the best possible cropping practices. Terraces in themselves do not improve soil fertility but serve primarily as a basis for other conservation practices that do improve the soil. Combined with other beneficial and allied practices, such as rotations within the field, strip cropping, and contour cultivation, terraces save fertile topsoil, seed, lime, and fertilizer. Terraced fields will produce better crop yields over a period of years than unterraced fields, if the terraces are properly built and maintained,

often making crop production possible when other methods fail. (Figs. 14, *A* and *B*).

Many farmers can construct terraces by using farm power and small equipment, although the work may be done more quickly and efficiently with experienced operators and large equipment. Light equipment, such as plows, fresno or slip scrapers, homemade or commercially built V-drags, small-blade graders, or one-way disk tillers drawn by farm tractors, horses, or mules, can be used to build satisfactory terraces if the farmer is willing to devote the extra time that the use of this equipment requires. Constructing terraces with small machinery costs little in actual cost outlay, and farm labor, power, and equipment can be utilized to advantage when not otherwise gainfully occupied.

The most satisfactory construction procedure varies according to the type of equipment used and the nature or condition of the soil. Experience and perseverence are required to develop proficiency, and the amount of work involved may vary considerably, owing to differences in soil conditions, equipment used, and skill of the operator. Detailed information on terracing is given in United States Department of Agriculture Farmers' Bulletin 1789, Terracing for Soil and Water Conservation.

CROP ROTATIONS GET RESULTS

Farmers cannot afford to think only in terms of a year or two of all-out production. They must think in terms of a long war and of years of world reconstruction after that. Obviously, a considerable increase in production could be obtained this year by simply plowing up cropland that was seeded to legumes and grasses last year as a part of the rotation for soil-building purposes (fig. 15). But if farmers are to have properly conditioned land to plow up next year, and the year after that, these seedings should be kept for 2 or 3 years. In addition, grass and legume fields are needed to supply seed needed for increased acreages of forage and cover crops and to supply hay and pasture needed for increased livestock production.

The crops needed for this war can be raised most cheaply, most surely, and with the least labor and power by using crop rotations that include soil-protecting and soil-building legumes and grasses. It has been proved many times that a rotation of crops, such as 1 year of corn, 1 year of oats, and 1 or more years of a legume and grass mixture, will produce more feed at a smaller cost per unit than will corn every year, or a rotation of corn and oats. On 10 fields in North Carolina and Tennessee, 1 to 4 years of annual lespedeza in the rotation increased the average annual yield of lint cotton from 223 pounds to 540 pounds an acre.

Legume crops in the rotation not only increase the yield of row crops following the turning under of these crops, but they also provide feed for livestock (fig. 16). Alfalfa, kudzu, red clover, sericea lespedeza, and sweetclover are outstanding examples.

But some legumes, like soybeans, cowpeas, and peanuts, require that the ground be worked each year, leaving it as bare as corn does after harvesting. Hence, these crops do not build up fertility to the same extent as to other legumes and grasses that do not require planting each year, that are more apt to be pastured, and that have larger root systems in relation to the tops.

Soybeans and other annual legumes grown on sloping land should be planted and cultivated on the contour to reduce soil losses and make better use of the rainfall. As most soybeans are harvested with combines, the straw should be kept on the ground, forming a light mulch and helping to hold back runoff water. Wherever the beans can be harvested early enough, small grain or some winter-

TEX.-2535; TEX.-2670

FIGURE 14.—*A*, Part of a farm abandoned because of drought and sandstorms in Sherman County, Tex., June 1936. The hummocks were leveled in August. Later, wheat was drilled, but it blew out. *B*, The field was terraced in February 1937 and planted to milo in July. This is the field in September.

467064°—42——3

growing legume, such as vetch, should be planted afterwards to provide additional cover and keep plant food from being leached out of the soil by winter and early spring rains (fig. 17). In many places earlier-maturing varieties are being used, so that small grain can make a good growth before freezing weather. As a soybean crop leaves the soil low in readily available plant food, an application of at least 200–300 pounds of fertilizer per acre will help greatly in getting a good fall growth of the grain.

ALA.-D2-39

FIGURE 15.—The yield of corn in this field near Dadeville, Ala., which was planted after kudzu had been plowed under, averaged 40 bushels an acre. The kudzu grew up after the corn was laid by. Phosphate was applied at the rate of 200 pounds an acre, but no nitrogen was added. Most corn yields in this section of Alabama averaged below 15 bushels an acre.

GROWING PEANUTS FOR OIL

The big increase in the acreage of peanuts to be dug and marketed for oil production presents a serious problem in keeping such land fit for crops next year and the years after that. While much of the increased acreage will be on level or slightly sloping land, a great deal of steeply sloping land will have to go into peanut production.

Fortunately, market peanuts are harvested early enough for the planting of winter legumes, such as blue lupine, Austrian Winter peas, or vetch, for winter cover. Unless peanuts are followed by a winter cover crop, the land is left unprotected against erosion, since the entire plant is harvested when peanuts are dug. As peanuts need an abundance of organic matter in the soil, winter legumes should be planted on land where peanuts will be raised the following season.

Like cotton and corn, peanuts are planted in rows and cultivated clean (fig. 18). Frequent, shallow cultivation is given until the vines

ARK.-10425

FIGURE 16.—The contrast between corn following 4 years of lespedeza (28 bushels per acre) and corn following 4 years of cotton and corn (7 bushels per acre), in Faulkner County, Ark. The corn on both plots had exactly the same care. Neither field received any fertilizer.

cover most of the ground. Planting on the contour, therefore, is an essential conservation practice for peanuts as well as for other row crops.

Heavy applications of fertilizer are not usually considered profitable for peanuts, since they do not repond to fertilizer as readily as most other crops. However, market peanuts remove large quantities of plant food from the soil. Peanuts planted on land of low fertility which has not been reasonably well fertilized within the past year and which definitely is not in a high state of production should have an application of a complete fertilizer relatively high in phosphorus and potash.

OH.-4010

FIGURE 17.—A good stand of wheat on the contour following soybeans keeps the land producing and protects the topsoil from washing. Morrow County, Ohio.

To obtain good winter cover, an application of 300 pounds of superphosphate or 600 pounds of basic slag per acre is recommended for winter legumes or small grain following peanuts. Small grain should also be top-dressed with 100 pounds of nitrate of soda per acre in the spring.

COVER CROPS

Cover crops are more important than ever in war years because they enable farmers to produce a part of the nitrogen needed to increase crop yields. Producing nitrogen at home saves money and helps conserve labor, materials, and transportation needed for military supplies.

Cover crops are grown to protect the soil during periods when it is not being used by the main crop. Cover crops prevent erosion, conserve moisture, hold plant food that might be leached out, and in many cases supply considerable feed for livestock (fig. 19). Cut and left on the surface, in orchards and vineyards, they continue to protect the soil, supply plant food to the main crop, and reduce evaporation. Some, like crotalaria and bur-clover, volunteer every year. Crotalaria is giving good results on the sandy soils of the Coastal Plains.

At Raymond, Miss., a summer cover crop of cowpeas with corn increased corn yields about 23 percent. At Tifton, Ga., for 9 years, cotton without a winter cover crop averaged 748 pounds of seed cotton. After Austrian Winter peas, it yielded 1,316 pounds; after monantha vetch, 1,452 pounds; after hairy vetch, 1,395 pounds; and after Abruzzi rye, 1,041 pounds. Similar increases in cotton yields by the use of cover crops were found at Raymond, Miss.

These results emphasize the great importance of winter cover crops, particularly now that war has limited the supply of nitrogen fertilizers. Under average conditions, an acre of winter legume cover crop will

take the place of 100 to 150 pounds of nitrate of soda. Since supplies of winter legume seed are limited, it will be necessary to make much larger use of grains, such as rye, winter wheat, barley, and oats, in order to seed all the land that needs winter cover.

In the Corn Belt and Northeastern States, where there is only one year of a row crop, such as corn or tobacco, in the rotation, fall-sown small grain serves very well as a cover crop. To be effective in protecting the soil, it must be sown early enough to make a good cover before cold weather stops growth. On rather poor soil, fertilizer should be applied to help get a good cover. At Bethany, Mo., cornland seeded to wheat in September 1936 lost only a ton of soil per acre during the fall and winter, while similar land in corn stubble lost 11 tons of soil per acre from September to April.

Where corn follows corn in the rotation, sweetclover, vetch, crimson clover, or one of the grasses such as ryegrass, or one of the annual bromegrasses may be sown as a cover crop at the last cultivation and plowed the following spring before planting the next corn crop.

ALA.–D7–19

FIGURE 18.—Runner peanuts were planted in rows through oats early in the spring. The oats have been harvested for grain and the peanuts have been given the first cultivation. The oats stubble provides protection against erosion, and by the time it is plowed up the peanut vines will furnish considerable ground cover.

CAL.-4243

FIGURE 19.—Clean-tilled irrigated land which has been furrowed, cross-checked, and planted to oats and sweetclover to conserve winter rainfall, in Orange County, Calif. This field held all the water from an 8-inch rain.

Blue lupine, a newcomer, appears to have a place as a winter cover crop in the Coastal Plains. This legume is an excellent seed producer, often making as much as 1,500 pounds of seed per acre. It is not as winter hardy as vetch and winter peas, but it has withstood temperatures of 10 degrees or lower. It is expected that 3 million pounds of lupine seed will be harvested in Alabama and Georgia in 1942 (fig. 20).

ALA.-D7-10

FIGURE 20.—Rows were opened through this field of blue lupine near Dothan, Ala., and corn was planted on the usual planting date. The lupine plants in the middles are protecting the soil against erosion and will leave a large amount of valuable residue after the seed is harvested.

FERTILIZING AND LIMING

Bigger and better crops can be grown by the careful use of fertilizer. In spite of transportation difficulties American farmers used more fertilizer in the 12-month period ending June 30, 1942, than ever before. It is expected that supplies of phosphate, potash, and lime will be available for further increase. The difficulty in transporting Chilean nitrate will complicate the nitrogen situation, increasing the use of other nitrogen-carrying materials and the importance of applying manure and growing legumes on the farm.

The greatest benefit from fertilizers can be obtained by applying them to the legumes and grasses in a good rotation of crops along with other conservation practices. If the grasses and legumes are being grown principally to provide cover for the soil, or green material to plow under, the fertilizer will increase growth, and the crops following will be benefited both by the greater degree of soil protection and by the greater quantity of organic matter and available plant food in the soil. Fertilizing grasses and legumes grown in rotation for soil improvement and used for hay or pasture makes it possible to produce considerably more meat and milk from the forage crops. Then, when the sod is turned, a more fertile soil is available for raising feed and other crops. The soil contains more plant food as a result of the fertilizer application and is in better condition on account of the greater growth of grass roots.

Available supplies of fertilizers will go much farther and do more good if they are placed in narrow bands alongside the plants in the rows or at each hill at the right depth for the roots to feed on them. While the location varies with different plants and different kinds of soil, the bands should be about 2 or 3 inches from the plants and about 2 to 3 inches deep. At present only about 60 percent of the fertilizer used is properly placed. If the balance were properly placed, the yield of crops which are so treated would be increased about 10 percent.

In 1938, in the Northern States, it was estimated by the Interbureau Coordinating Committee on Fertilizer, that corn production was increased about 86 million bushels by the application of less than a half million tons of fertilizer. The average application was 150 pounds and the average increase was 13½ bushels of corn per acre. In the same area, wheat yields were increased 14.7 bushels per acre by applying 190 pounds of fertilizer per acre. In a series of experiments in Georgia, covering 5 seasons, 16 pounds of nitrogen per acre increased the yield of seed cotton from 555 to 733 pounds. Thirty-two pounds of nitrogen per acre increased the yield from 555 to 967 pounds per acre.

Where good crop rotations are used with either annual or perennial legumes, fertilizer requirements are confined largely to phosphate and potash, most of the necessary nitrogen being derived from legumes. Certain amounts of lime are also necessary on many soils to get the best growth of legumes.

Farmers can help to reduce the shortages of labor, fertilizer, bags, and railway cars by using higher analysis fertilizer, such as 18-, 20-, and 22-percent mixtures. While the cost per ton is higher for the higher grades, a ton will go farther and the cost of a unit of fertilizing value is often much less. About 450 pounds of sand, salt, and ashes per

ton of fertilizer go into the manufacture of the lower grades. The farmer pays about $10 per ton for such material but gets practically no plant food in return.

Since there are limitations on the manufacture and transportation of commercial fertilizers, the greatest opportunities for increasing production by fertilizing are in the saving and application of manure. About 70 percent of our crops are fed to animals, and over 75 percent of the fertilizing value in these feed crops is left on the farms in the form of manure. In other words, fully 50 percent of the fertilizing elements taken from the soil by all harvested crops in the United States are left on the farms where livestock are fed.

SPREADING RICHER MANURE

With the present opportunities for increased production and with possible shortages of commercial fertilizers, it will pay well to take the best possible care of all manure and to see that it gets back into the soil where it will do the most good. It is important to remember that about half the fertilizing value is in the liquid manure.

To save the liquid, barns should have watertight floors and should be bedded well enough to absorb all liquids. Lots, yards, or paddocks should be either small enough to be watertight or well bedded, or should be large enough to serve as good pastures. Large mud lots that are used in winter and left to weeds in summer are too costly to keep. If lots are sufficiently small, they can be kept well bedded. At the Ohio Experiment Station, it was found in fattening steers on an earth floor that enough liquid manure was lost in 12 months to pay for a concrete floor. Smaller lots mean keeping the various kinds of livestock separated, but they also reduce the labor and cost of feeding. The only important advantage in mixing stock in the lots is that of running hogs with fattening steers to get the grain in the manure.

In handling manure, the most important precaution is to keep it from heating when it is fresh and thereby losing nitrogen in the form of ammonia. If it is packed under the feet of the stock in a barn or shed, or is stored in a watertight pit and kept moist, wasteful heating will not occur. When manure is piled on the ground in the open and left exposed to the weather for several months, one-third to one-half of its value is wasted.

When manure is spread on a field it should be mixed immediately with the soil, preferably by disking, to keep ammonia from being lost in the air. While this danger is greatest in warm weather, much of the ammonia may be lost within 2 days after spreading in freezing weather. The loss is greatly reduced if a rain falls soon after the manure is spread. Leaving the manure in piles in the fields should be avoided. On the other hand, adding phosphate to the fresh manure in the barns helps to keep down losses of nitrogen.

The average cow, or an equivalent weight unit of other livestock, produces about 1 ton of manure per month when enough bedding is used. About two-thirds of the annual production is dropped in the barns and lots. According to the experiment station in Indiana, manure is worth about $3.60 per ton when corn is worth 75 cents per bushel. At this rate, the annual value of manure from the livestock on a farm keeping 5 cows, 3 young cattle, 3 horses, 5 sows, and fattening 60 pigs, is about $633. With good care, 80 percent of this value

can be returned to the soil. But if only 50 percent is returned, there is a loss of $190 each year which can easily be avoided. Saving this loss would add 253 bushels of corn or its equivalent in other feed. In the Corn Belt this would be equal to growing 6 acres more corn per farm. In a comparison of grain and livestock systems of farming for a 27-year period, the Ohio Agricultural Experiment Station found that ear-corn yields were 10 percent greater; soybean yields, 14 percent greater; and wheat yields, 12 percent greater, where all of the grain and roughage, excepting the wheat grain, was used as livestock feed and bedding, than where all the grain was sold and all the residues and the legume crop every fourth year were used as mulch or plowed under.

ALA.-D9-5

FIGURE 21.—Mr. Carroll, of Cullman County, Ala., does not believe in burning cornstalks. He figured that the stalks from his 40-bushel corn crop in 1940 were worth $5 per acre left on the ground for soil protection and fertilizer.

STALK AND STUBBLE SAVING

Who would think of touching a match to a handful of dollar bills? Farmers do almost the same thing when they go into a field and burn corn, cotton, and sweetclover stalks, grain stubble, or even a weed crop. They save the bother of chopping them up, mixing them with the soil, or turning them under, but they lose nitrogen at the rate of $2 to $4 for each ton of such material that is burned. In addition to the losses in fertilizer value, these crop residues are needed to improve the mellowness of the soil, make it more porous, increase its water-holding capacity, protect it against erosion by wind or water, and to make available more of the mineral plant foods in the soil (fig. 21).

In order to get the greatest benefits from crop residues, they should be so handled as to produce a mulch on the surface of the soil. For

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such crops as corn and cotton, the stalks should be chopped or cut into short lengths immediately after harvesting is completed, to provide the necessary protection of the soil and at the same time to prepare for the tillage that follows. The stubble, straw, and other residues from grain, hay, or pasture crops will give more protection to the soil and help more to increase crop yields if retained on the surface during tillage operations than if plowed under (fig. 22).

In order to maintain crop residues on the surface for mulching purposes, the farmer may find it necessary to modify his present tillage implements. One of the simplest and easiest ways is to remove the moldboard from the ordinary moldboard plow. By this means an implement is made which lifts and breaks the soil without burying the crop residues (fig. 23). Other implements which may be used to till the land and leave crop residues on the surface include the bull-tongue plow, the one-way disk, the rod weeder, the straight blade cultivator, and the large duckfoot or sweep-shovel cultivators.

Seeding or planting equipment may require some adjustments or additions to enable it to operate satisfactorily through trash on the surface. The semifurrow or deep-furrow drills have been found most satisfactory for seeding grain. The addition of a coulter or jointer to row-crop planters may be all that is necessary to cut or move the trash aside and let the furrow opener place the seed in compact, moist soil.

In some sections extra heavy quantities of crop residues may reduce yields of the crop that follows, unless some nitrogen is applied at the time of plowing. It has been found that the application of nitrogen with cornstalks not only eliminates this danger but increases yields sufficiently to more than pay for the fertilizer and cost of application. The nitrogen fertilizer will make the stalks rot faster and give the crop being planted a larger supply of plant food to start growth.

INCREASING PRODUCTION THROUGH LAND DEVELOPMENT

Construction of drainage works and irrigation systems to bring undeveloped land into production, and improvement of present drainage and irrigation systems are usually costly in labor, material, and equipment. The help of well-trained men is required to insure satisfactory results. Such operations must be counted as an investment which will produce sufficient returns over a period of years to show some profit and maintain the investment. In undertaking such operations, farmers usually need technical help in such matters as determining how the soil will react to the proposed treatment; location and size of drains, ditches, and other mechanical structures; the materials and equipment to use in the installation of the structures; and the crops that will suit the land best after the work is done (fig. 24).

MAKING WET LAND MORE PRODUCTIVE

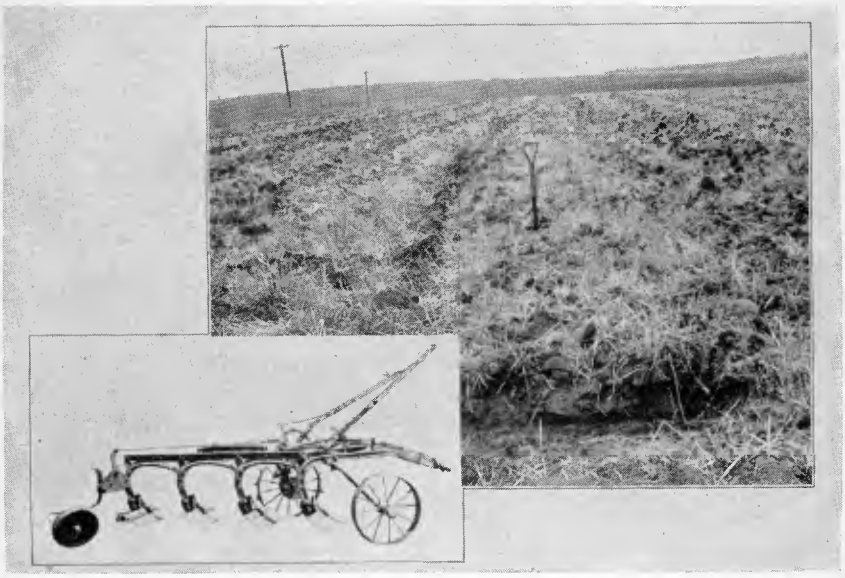
Improved drainage works, such as ditches and tile drains, are among the best means of increasing crop yields on flat farmland without increasing the danger of erosion. The actual cost of planting and cultivating is usually reduced and crop returns are materially increased. By draining bottom land and other wet spots on farms, the most fertile land on the farm often may be reclaimed and put to the most intensive use (fig. 25). This not only increases crop production but it permits

NEBR.-1239; NEBR.-1240

FIGURE 22.—*A*, In Stanton County, Nebr., one farmer used subsurface tillage on an old alfalfa field in the fall of 1940 and raised 49 bushels of corn per acre in 1941. *B*, His neighbor, with the same kind of alfalfa land, did not break his ground until the spring of 1941 and made 16 bushels of corn per acre. Fall subsurface tillage, with the alfalfa stubble kept on the surface, reduced runoff and evaporation and stored more water for the growing crop.

the use of the steeper lands for pasture or hay. On many farms drainage is necessary before conservation practices such as terracing and strip cropping can be employed.

Drainage can directly aid wartime production, not only by increasing production on existing farms, but also by bringing new flat lands not subject to erosion into production. To meet demands created by the last war, much land subject to severe erosion was put under cultivation. This mistake should not be repeated. Instead, the good lands and potentially good lands should be used more intensively. On farm lands where drainage work is practical, considerably more food per man and per acre can be produced than on similar areas of poor and badly eroded uplands now being farmed.



C-8285; FIELD WN-5102; PLOW IDA-2511

FIGURE 23.—A wheat stubble field after it was plowed with the plow with the moldboards removed, as shown in the insert. Most of the straw has been left on the surface to increase the movement of water into the soil, to reduce evaporation of soil moisture, and to keep the soil from being moved out of the field by wind and water.

With better farm prices and the need for increased food production in wartime, farmers should make every effort to improve drainage on their farms. Most immediate benefits probably can be obtained by individual farmers and small groups of farmers undertaking the farm-drainage operations which they can do by hand work, teams, or a farm tractor (fig. 26). Open drains should be cleaned out regularly and graded uniformly so the drainage water will flow off without obstruction. Regular inspection and maintenance of farm drains means better drainage and better crops.

Fields should be inspected following heavy rains. If the soil is too heavy or if the slope is too flat, ponding may occur over considerable areas. Often plowing the fields in "lands" with dead furrows 50 to 80 feet apart will aid surface drainage.

TEX.-1449

FIGURE 24.—A pump irrigation system, costing $1,920 for 38 acres, near Dalhart, Tex., photographed in November 1940. The farmer estimated that the grain sorghum yielded 8 tons per acre when dry farming in the vicinity was a failure.

FIGURE 25.—Corn on drained land in the Corn Belt often yields 70 to 100 bushels per acre. The Illinois field shown in the picture was formerly swampland. The corn was 7 to 8 feet tall when the picture was taken, on July 22.

Frequently drainage ditches have high spoil banks which keep the water in the fields from flowing into the ditches. This can be corrected by providing suitable openings through spoil banks and protecting the inlet from erosion with close-growing vegetation. Where practical, all plowing should be done away from ditches so as gradually to level the spoil bank. Often it will pay to level the spoil bank with equipment at hand and use it for growing a hay crop, which will protect the bank from washing into the ditch.

Tile drains are used profitably on many farms. Because they are a sound investment, bankers often lend money to install them. Tile drains require maintenance, and simple repair work performed in time may save considerable expense later. In many cases better underdrainage contributes directly to control of erosion; water that soaks into the ground and drains off as underground flow does not wash away the soil.

IA.-137

FIGURE 26.—Clearing out a tile drain in a waterlogged field on a farm near Kingston, Iowa.

THE REPAIR OF COMMUNITY DRAINS

Another serious drainage problem in many areas is the problem of repair and rehabilitation of community drains. Many groups of farmers and landowners have found it necessary to form legal drainage enterprises and construct community drainage works, usually with the object of providing the farm with a suitable drainage outlet. Many of these community drainage projects have depreciated and are not as effective as they should be. A recent estimate indicates that cleaning and improvement of community drainage enterprises affecting about 24,600,000 acres of farm land is needed.

Another 4,300,000 acres located within community drainage enterprises is still undeveloped. A considerable portion of it is in the Mississippi Delta. Much of this land is very productive when properly drained. Rehabilitation of community drains, construction of farm drains, and clearing of cut-over land will place most of it in condition for use.

THE DRAINAGE OF UNDEVELOPED LAND

Outside of organized drainage enterprises are extensive areas of land classified as wet, swamp, and overflow land. Most of this is unsuited to cultivation, but some 6 million acres which are partially farmed could be provided with community drainage outlets at reasonable cost. In addition, it is estimated that 13,600,000 acres of undeveloped wet lands could be drained economically. These figures include only the most productive areas; most of the large areas of swamp lands no doubt will continue to be used chiefly for forestry and wildlife purposes.

While large areas can be brought under cultivation by drainage, it is important that such projects be selected with utmost care. Before and during the last war, drainage was overexpanded and some unwise projects were undertaken. Future drainage projects should be undertaken only after the suitability of the soils has been determined, sound engineering designs developed, and economic soundness appraised. Adequate provisions should be made for maintenance.

One example of how quickly drainage can aid in crop production is illustrated by the results secured on a farm near Elkins, W. Va. The field to be drained was too wet to grow any cultivated crops, and it was of little value for pasture. A drainage plan was worked out in the fall of 1940 and necessary drains were installed within a few months. The 1941 yields amounted to an average of 220 bushels of potatoes per acre from 16 acres, and 70 bushels of corn per acre from 18 acres. Many farmers can drain their flat fields during the present emergency and often can secure similarly beneficial results.

IRRIGATION

A considerable increase can be obtained in the production of foods by the improvement and rehabilitation of existing irrigation enterprises, and the adoption of sound methods of water management. The present war emergency makes it necessary that structural repairs and improvements be limited to an absolute minimum necessary to essential operating needs, however, one of the most important factors which controls crop production is the actual application of water to the crops. The adoption of sound methods of water application alone will pay big dividends in increased yields (fig. 27). In fact, at present approximately 11 percent of our total production comes from irrigated land. In arid and semiarid sections water is the limiting factor in the development of irrigation, and water supplies are determined by conditions on the watershed. These supplies must be safeguarded by proper stocking and forest management on the lands that drain into the streams. The quantity and quality of water available for irrigation use is dependent upon such watershed protection.

In humid sections, the application of additional water is often needed during long dry periods and may be justified where water is available at a low cost and high returns per acre can be obtained.

The problems of securing more efficient agricultural uses of water are numerous and frequently difficult to solve. In many cases the establishment of corrective measures will require organized group action. Some of the problems common to large numbers of farms are centered around poor distribution systems, improper land preparation,

WN.–35274

FIGURE 27.—A portable hammer-head sprinkler system irrigating alfalfa near Deer Park, Wash., where winter rains are fairly abundant but summer rains are scanty. This means of increasing summer forage production has increased annual butterfat production per cow by 30 percent on one farm in the neighborhood.

N. M.–11707

FIGURE 28.—A steeply sloping New Mexico farm where recently constructed bench terraces, wooden turn-out boxes and ditch drops, made of rough stone and mortar and halves of old oil barrels, control irrigation water, eliminate erosion, and insure greater production of wartime foods.

wasteful irrigation practices, needs for fertilizing and for soil-building rotations, need for weed control, and needs for control of alkali and for soil drainage.

The solution of these problems requires the adoption of farming methods and soil-building practices which are consistent with the kinds of crops grown and the variability of the soils in each farm field. The farmer must study the physical characteristics, the use capabilities, and the plant-food requirements of his soils. The farm and the distribution system, including borders, furrows, corrugations, and other related works, should be arranged so that an even distribution of water can be supplied to the root zones of the plants with the least waste of water, soil, and plant food (fig. 28). A knowledge of the development of the root systems of the various kinds of plants is helpful in determining the right amount of water to secure the desired moisture penetration into the soil. The farmer should learn to estimate the soil moisture content in various parts of the fields in order to determine when water should be applied. The use of too much water may drown the crops, cause waterlogging, leach out valuable plant food, and in many instances cause soil erosion.

In the early part of the growing season, water requirements of crops are small. It is necessary to increase the amount of water with successive applications to promote good root penetration and plant growth. Where water-storage facilities are limited, it is most important that sufficient reserve supplies be kept for the heavier late-season demands as the crops approach maturity. Cultivation between irrigations will control weed growth and assist in conserving soil moisture for plant use.

In some irrigated localities weather conditions are so severe between irrigation seasons that farmers have very little time to make needed repairs and improvements. This makes it necessary that all parts of the farm distribution system be kept in good repair at all times. Frequent inspections should be made of ditchbanks and of structures. Ditches should be cleaned every season; weeds and rodents should be systematically controlled.

MAKING PASTURES PRODUCE MORE

Pasture land, like cropland, must produce its full part (fig. 29). Where new pastures can be established readily, pastures located on good tillable land may be plowed up and used in rotation with crops, and a part of the land that has been in crops should be made into a pasture. Rotating pastures with cultivated crops on different fields reduces trouble with parasites which affect all classes of livestock.

Certainly our country will gain nothing by the breaking up of rough pasture land or range land which is not suited for cultivation. That would result in inefficient and high-cost production during the next few years, and erosion would cause great damage to such lands and might destroy their value not only for crops but even for pasture. Furthermore, much of the soil washed from such land would be deposited on land in the valleys and reduce their production. During a long war it would do more harm than good to ruin productive land for the sake of one or two crops.

Since the war has caused increased demand for livestock and livestock products, and since pasture is one of the best and cheapest

sources of livestock feed, grazing capacity of pasture should be increased in every way possible. Liming, fertilization, mowing weeds, and proper grazing are things every farmer can do to improve pasture. Poor pastures that do not have enough clover or lespedeza can be renovated by disking, liming, fertilizing, and seeding more productive grasses and legumes (fig. 30).

The grazing season can be increased by providing several kinds of pasture, including perennial grasses and legumes such as bluegrass, Bermuda grass, and white clover; annual grasses and legumes such as small grain, Sudan grass, and lespedeza; stubble fields, meadow aftermath, and crops that may be hogged off to save labor.

Use of supplementary pastures will increase livestock production by providing a more constant supply of grazing. Perennial legumes, such as alfalfa, kudzu, and sericea lespedeza, grown principally for hay on land that is too steep to cultivate, are very valuable for supplementary pasture. So are clover and lespedeza grown in stubble fields. Such supplementary grazing will keep cattle gaining and prevent declines in milk production.

Getting the stock off the permanent pasture for a few weeks allows plants such as white clover, lespedeza, and Dallis grass a better opportunity to produce seed. Electric fences, being easy to construct and move, are very effective in making use of all the grazing on the farm, including crop residues and crops to be hogged off.

On many farms there is idle land that has been abandoned because it ceased to pay for plowing and seemed too poor to rebuid with grass., But improved methods have brought new uses for such lands. Some should be planted to trees. Some should be prepareld for seeding fertilized—possibly limed—and planted to pasture plants that are well adapted to the land. Such land may need a few years under

UTAH-604

FIGURE 29.—Irrigated pastures, like this one in northern Utah, improve the soil and yield more feed for dairy cows and other livestock, thereby increasing products needed in wartime. Such pastures carry as many as three cows per acre during the season.

C-6936

FIGURE 30.—Six acres of this old weedy bluegrass pasture have been renovated by liming, fertilizing, disking, and reseeding with deep-rooted legumes. This picture was taken in June after 3 weeks of grazing by 17 cows. Production is usually increased 50 to 100 percent by such pasture renovation, which costs from $10 to $15 an acre.

some soil builder like sweetclover, lespedeza, or kudzu before it is ready for plants like alfalfa, bur-clover, bluegrass, and Dallis grass that require a fertile soil (fig. 31, *A* and *B*).

CAREFUL GRAZING INCREASES PRODUCTION

Pasture land that is sufficiently fertile to produce a good yield of corn should carry one cow per acre through most of the growing season (fig. 32). With good management, land in pasture will produce about three-fourths as much feed as the same land in corn. Of course, such feed is much cheaper per unit, on account of the saving in plowing, planting, cultivating, and harvesting. But, like corn, grass cannot grow well without plant food. Legumes are needed in the pasture to get nitrogen from the air. Under average conditions about one-third of the pasture plants should be legumes. Lime, phosphate, and potash are needed to make the legumes grow well. Mixtures of grass and legumes produce one-third to one-half more pasture feed than grasses alone. The grasses make more growth on account of the nitrogen they get from the legumes. The yield is also increased because two or more different kinds of plants in one place usually make more growth than one alone.

Again, as with corn, the leaves of pasture grass are a very important part of the plant. If they are eaten off too closely and too often, the plant is stunted or dies. To avoid this, well-managed pastures are allowed to make 3 or 4 inches of growth in the spring before the stock is turned on them. Then, when hot and dry weather in midsummer stops their growth, other pastures, such as alfalfa, clover, lespedeza, kudzu, or Sudan should be provided. Fall rains usually revive the pasture and afford good grazing, but the stock should be taken off again in time to let the plants make some growth and store up some food in the roots for a good early start the next spring.

GA.-40071; GA.-40071B

FIGURE 31.—*A*, Wasteland like this Georgia hillside brings in no money to the farmer. *B*, The same field after 3 years in kudzu. Instead of eroding wasteland, the hillside has become a valuable hayfield or grazing lot. It was planted to kudzu in March 1937, photographed in September 1939.

At Dixon Springs, in southern Illinois, two pasture plots of similar productivity and equal area were treated with lime and phosphate and seeded to the same pasture mixture in 1936. Beginning in 1938, one pasture was purposely overgrazed for 3 seasons, while the other was carefully managed to avoid overgrazing.

In June 1941, the overgrazed pasture consisted of 20 percent grass; 5 percent lespedeza; 32 percent weeds, and 43 percent bare ground. In the moderately grazed pasture there was 45 percent grass; 19 percent lespedeza; 9 percent weeds, and 27 percent bare ground. In 1941, 13 percent more rainfall soaked into the ground on the moderately grazed pasture, where there was a better cover than on the

KANS.-1327

FIGURE 32.—A smooth bromegrass, sweetclover, and Korean lespedeza rotation pasture of high carrying capacity near Parsons, Kans., in May 1941. On land that is suitable for cultivation, rotation pastures are much more productive than permanent pastures, and they produce big crops when they are broken.

severely grazed one. This extra soil moisture is especially important during midsummer when it is often too dry for grass to grow.

During the grazing season of 1941 both pastures were grazed with the same number of sheep for the same period of time. On the overgrazed plot the sheep lost weight at the rate of 72 pounds per acre for the season. On the other plot the sheep gained at the rate of 126 pounds per acre.

Of course, few farmers would graze their pastures so heavily that such losses in weight would occur year after year. However, many farmers do not take full advantage of the possibilities of increasing livestock gains through regulated grazing. Overstocking results in lower production of grass and still lower gains of livestock in succeeding years (fig. 33).

EXTENSION SERVICE S12083C

FIGURE 33.—Keeping the grass ahead of the stock insures greater yield of feed and produces heavier and better finished animals.

PROTECTING RANGE LANDS

Of the millions of the country's farm and ranch families on whom the United States is depending to furnish agricultural commodities vital for war purposes, about one-sixth are dependent in whole or in part on range agriculture. The Nation's range lands, the uncultivated and unfertilized lands supporting native grasses and other forage plants, support for some part of the year about 73 percent of the sheep and goats of the United States and 53 percent of the beef cattle, as well as large numbers of other livestock. From the rangeland territory of the West and South comes more than 80 percent of the Nation's wool and 40 percent of the meat and hides. It is in the range territory that a large portion of the feeder livestock is produced for fattening on farms in the Corn Belt and other fattening areas of the country. In the western range territory about 65 percent of all the forage and feed of the livestock comes from range lands.

Livestock production on range lands, together with the growing of related farm products, is the mainstay of a large part of the country's farm population. The range in the 17 Western States covers more than three-quarters of a billion acres, about 40 percent of the total land area of the United States. Practically all of it is available for grazing. In the Ozarks and the South, livestock production from range lands means much in the welfare of the rural population and contributes greatly to human needs. In the country as a whole, the range contributes materially to the support of numerous urban communities, and in wartime the range helps to supply the huge demands for meat, wool, and leather for a nation at war.

The expansion of herds that accompanied World War I was followed by depleted ranges, forced liquidation, increased indebtedness, and demoralized markets—tragedies from which the livestock industry has not yet recovered (fig. 34). With livestock numbers already exceeding those of 1918, there is a very real danger these tragedies will be repeated. They can be avoided only by increased marketing of excess animals, the avoidance of expansion and speculation in livestock operations, and careful management of range lands.

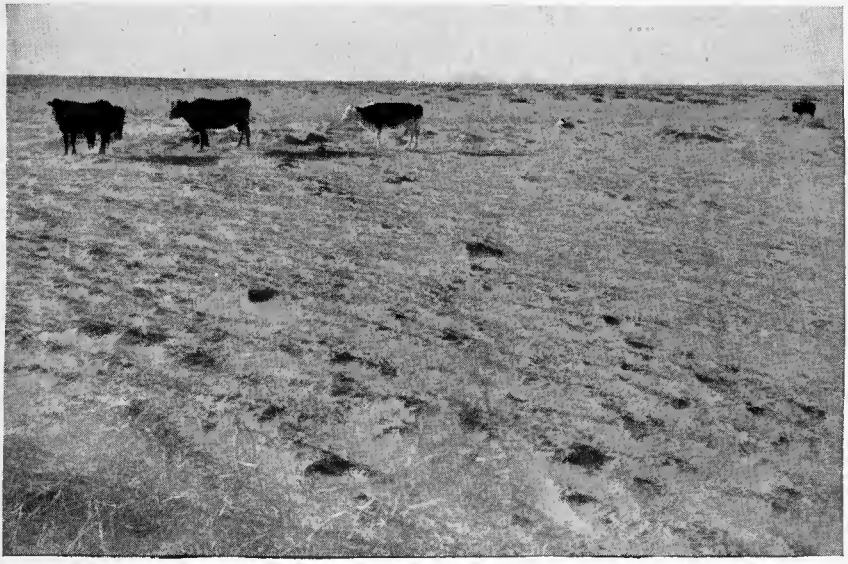
The most effective means of keeping the range lands productive and maintaining high production of livestock and livestock products is to balance the number of livestock with the amount of forage produced, allowing enough forage always to remain on the ground to maintain the better range plants, control soil erosion, and leave a little extra forage for reserve. If ranges have been run down through overuse in the past, they should be favored still further, giving the plants a chance to grow (fig. 35).

Efficient livestock production on the range requires that the nutritious plants not be grazed beyond their ability to survive. The amount each kind of plant can be grazed varies according to locality, growing conditions, and the severity of past use. So long as grazing does not outstrip plant growth, range plants will continue to make maximum use of the nutrients in the soil. Grazed too heavily, they gradually weaken and die, and either leave the ground entirely bare or are replaced by plants less able to protect the ground from erosion or to produce nutritious feed.

In all cases, healthy, vigorous plants hold the upper layer of soil firmly in place and give unusually strong protection against soil removal either by wind or flowing water. If the soil is protected against these destructive forces, the food materials stored in the valuable topsoils will be available for sustained forage production and maximum livestock production (fig. 36).

DEFERRED GRAZING INSURES MORE FEED

The cure for overgrazing is in the natural recuperative powers of the grasses themselves, and the chief task is to give them a fair opportunity. The essential requirement is to protect them from grazing while they make and store food for growth and produce seed



N. M. -34

FIGURE 34.—Thin cattle and poor range. Overstocking followed by drought brought ruin to many cattlemen a few years back.

As grasses are most easily damaged when they are becoming green in the spring, grazing should be deferred until the grasses have a good start. Deferred grazing does not mean a loss of feed. In fact, it is possible to harvest the same amount or more forage while the range is improving. But to get started with deferred grazing in the spring,

FIGURE 35.—*A*, A range area after years of too heavy use. The better plants have been killed or weakened and much of the topsoil has washed off. *B*, The same area under good management, with recovery well on the way.

it is necessary to provide more winter feed to carry the stock until the grass has made a good growth. Then, with as much or more than the usual forage, the stock should be in better condition when they come off the range in the fall, or they may be carried on the range somewhat longer in the fall.

A system of grazing under which different pastures are protected in rotation over a period of years can be worked out for most ranches.

TEX.-14627

FIGURE 36.—Well-bred cattle on a good cover of native grass which was restored after 5 years of growing wheat in Deaf Smith County, Tex. Wind damage had made continued wheat production unprofitable.

A part of the ranch is protected from grazing during the full growing season of one year and a part of a second season. It is protected the first year until seeds have been produced and the old plants have had a chance for expansion in root or runner systems; it may be grazed after full maturity or during the open winter months. The same part is reserved from grazing during the spring and summer of the following year to protect the new seedlings and young plants. In succeeding years, the system of deferment and part-year protection is extended to the remaining areas of the ranch unit in rotation until all portions have had the benefit of deferred use. This system is so effective that many ranchers continue its use as a regular system of operation after the range land has been restored to a high state of productivity.

Natural reseeding is the most practical means of obtaining range recovery where sufficient remnants of the desirable forage plants remain. Artificial revegetation by broadcasting, drilling, harrowing, or trampling seed into the ground may be justified on suitable sites where remnants of the desirable plant cover are insufficient or lacking. In establishing strong stands reseeded areas must usually be fenced and protected from grazing during the first two growing seasons.(fig. 37).

MONT.-5182-B

FIGURE 37—Crested wheatgrass and western wheatgrass seeded in September 1938 on a farm near Culbertson, Mont., had made a good growth by June 12, 1939, when this photograph was taken.

FENCES AND WELL-SPACED STOCK WATER AND SALT SAVE GRASS

An improved system of grazing management usually calls for good fences. Fences shut out trespassing livestock and facilitate the distribution of livestock in the various pastures according to the proper season of use and the proportionate grazing capacity of the pastures. They assist in preventing certain favored areas from being overgrazed and serve to hold livestock on pastures where forage is plentiful. They are essential in connection with deferred and rotation grazing, except with herded sheep.

Well-spaced water supplies developed on the range in adequate number will enable livestock to secure water without trampling out the vegetation or walking off gains. The main consideration is to see that water is adequate in each portion of the range for the number of livestock the forage will support at the time of year the forage should be grazed.

Salting away from water is used as a means of drawing livestock into the more remote and less-used portions of the range and securing more even utilization of the range as a whole. Following a well-considered rotational salting plan will result in an improved range and an increase in the production of livestock and livestock products.

FEED RESERVES FOR THE BAD YEARS

Supplemental pastures and forage crops reduce the bad effects of poor growing seasons and long, hard winters. Storing supplies of

TEX.-372

FIGURE 38.—Filling a 1,000-ton trench silo with grain sorghum near Texline, Dallam County, Tex. Reserve feed stored in good crop years is the best insurance against having to sell cattle cheaply or buying high-priced feed in drought years.

roughage capable of completely replacing range forage in years of range failure is a good practice, especially in wartime (fig. 38).

Establishing feed reserves in years of abundant production not only is a safeguard against seasons of low crop production but helps temporarily in adjusting the grazing load on range lands to meet the growth requirements of range plants (fig. 39).

On many ranches supplemental crops of wheat, rye, sweetclover, and grass can be provided for spring use, thus protecting the range from early overgrazing. In the high-altitude sections, native hay meadows may be used to provide green feed during this critical period.

When reduction of livestock numbers on a ranch or portion of a ranch is necessary either temporarily or permanently in order to secure a maximum sustained poundage of beef, mutton, and other livestock products, it may be desirable to adjust somewhat the plan of ranch operation to fit the new conditions.

A better balance of seasonal use may be achieved by grazing a portion of a hay meadow, raising more forage crops and feeding them during a longer period in the spring and fall, or pasturing winter wheat, rye, sweetclover, or Sudan grass. Leasing irrigated pastures may be the most feasible solution. In any event, for maximum production, the herds should be culled and the cull animals marketed.

Results of these practices—adjusting livestock numbers to the capacity of the range, basing the time of use upon the growth requirements and productive abilities of the desirable forage plants, grazing the range with the kind of livestock best suited to it, distributing the livestock in accordance with the amount of forage available in

the various portions of the range, establishing reserve and supplemental forage supplies, and reseeding of depleted and denuded areas—will be reflected in high-yielding ranges, higher beef, mutton, and wool production, better lamb and calf crops, and a stabilized livestock business (fig 40).

An outstanding example of increased production from properly stocked and managed range land comes from the Victorio Land and Cattle Company in New Mexico. During a 4-year period with an average of 8,674 breeding cows on the range, the calf crop averaged 66 percent and the weanling calves averaged 341 pounds, making a total of 1,952,225 pounds per year. During the next 4 years, under improved range management, an average of 6,190 breeding cows produced a 91-percent calf crop, weighing an average of 445 pounds each at weaning time and a total of 2,506,685 pounds per year. Not only do the records reflect this amazing increase in beef production, but surveys of the range show an average increase of approximately 20 percent in forage production brought about by proper stocking and management of range and stock.

A sheep raiser in the Southern Otero County Land Utilization Project in Colorado was enabled to realize a substantial increase in financial returns from his operations during a 5-year period as the result of good range-conservation practices combined with necessary adjustments in ranch and livestock holdings. This was done in the face of a reduction of flock from 4,000 to 3,000 head. While the number of lambs produced and sold was lower, the average weight of lambs was increased 14 percent and the total weight of lambs pro-

WYO.-392

FIGURE 39.—Western wheatgrass yielding 2 tons per acre displaces greasewood on Tom Rennard's ranch in Niobrara County, Wyo. An earth dam spreads flood water on about 150 acres that had been producing about 150 pounds of forage per acre.

COLO.-772

FIGURE 40.—A reduction in this herd of Herefords on a Colorado ranch brought about a 100-percent calf crop, better animals, more forage, and a higher net income to the owner.

duced from the smaller flock was actually greater. There was no decrease in the total wool clip. The reduction in the number of livestock resulted in lower taxes, and relieved the demand on the range to the point where the forage could maintain itself and furnish adequate protection to the soil from erosion.

WOODLAND'S PART IN THE WAR

Wood is an essential war material. The growing of wood takes its place on farms alongside the production of food, fiber, and oil crops. Shortages of metals have increased the importance of wood. Camps, barracks, new factories, houses for factory workers, and other wartime buildings require many hundred million board feet of lumber. Shipbuilding still utilizes large quantities of timber. Wooden boxes and crates are necessary for packing many war goods, such as food, airplanes, guns, and ammunition. It is estimated that in 1941 over 10 billion board feet, or about 31 percent of our total lumber consumption, was used more or less directly in national defense work. War also increases the demand for other forest products, such as paper, naval stores, maple sugar, and charcoal.

As always, an important part of the national wood needs must come from farm woodlands. Reports indicate that the war has caused widespread and generally destructive timber cutting on farms. Clear-cutting of farm woodlands on an extensive scale is bad business at any time. Selling farm timber for a "lump sum" or "by the boundary" is a dangerous practice because it gives the buyer the opportunity to cut and slash at will.

The areas so stripped of trees are subject to further damage from fire, which may destroy not only the seed on the ground and the small seedlings, but also the occasional seed trees that escaped the loggers. As a result, it is frequently necessary to plant trees to bring such areas back into production, and further income from the land may be delayed many years. Meanwhile, taxes and other charges continue placing a difficult burden on the rest of the farm land.

IND.-28263

FIGURE 41.—Good-quality sawlogs, fuel wood, and posts from the same cutting in a Henry County, Ind., farm woods.

The wise farmer manages his woods as a crop, using his spare time and keeping his hired help at work cutting timber selectively for sustained yields. Ordinarily this means cutting the fully mature trees each year. Now with the wartime need for more lumber and with better prices for logs, farmers are justified in marketing in 1 year such trees as might not be cut for 5 to 10 years in peacetime (fig. 41).

The improved demand for wood products offers an opportunity to market the rough, crooked, and other undesirable trees scattered through the woods, along with the ripe trees, allowing the young, thrifty well-formed trees to grow faster as a result of the "culling." The ripe trees are usually from 16 to 30 inches in diameter, varying with the kind and site.

Maximum wood crops, year in and year out, are obtained by cutting only scattered trees at any one time, taking especially those that are crowding their neighbors. The crowns of the neighboring trees grow out into the vacant space in a few years and then another tree or two in the group may be cut. In this way, cutting can be done every year or every few years, giving the trees remaining each time more room in which to grow.

The protection of woods and fields from fire is fundamental; fire lanes should be kept cleared, tools for fire fighting should be available, and every effort should be made to prevent fires from starting.

Grazing should be so restricted in farm woods that no damage will be done to the young trees. Except in the Coastal Plains and on western forest ranges, it usually pays to avoid all grazing of woodland. The forage value of woodland pastures is usually so low that it is

NEBR.-73; NEBR.-73C

FIGURE 42.—*A*, An old Nebraska gully becomes a wood lot and wildlife refuge on the Max Siert farm near Omaha. Trees and shrubs were planted in May 1936 when this picture was taken. *B*, The same gully in September 1940. Siert reports that some of the larger trees will now supply posts as he needs them, and that birds have thronged to this planting. Birds pay well for such protection because they prey on crop pests.

poor farm management to continue to use them for two purposes. If the site permits the developing of improved pasture and if more pasture acreage is needed, wooded pastures should be cleared, treated, and managed so as to improve their grazing value. If not, grazing should be stopped and the wooded areas managed for the production of wood crops.

Growing, harvesting, and marketing the farm woods crop is as much a part of farming as the production and sale of any other farm crop. At the mill, timber usually brings from three to five times as much as it does when sold "on the stump." The successful farmer is one who runs his own business, from the production of the tree to the delivery of products to the mill.

WILDLIFE PRODUCTION FROM UNUSED LANDS

Almost 40 million acres of American farm land are wholly unsuited for the production of cultivated crops, hay, pasture, or even tree products. The area involved is as large as New England. The Nation certainly cannot afford to waste this much land or to try to make it produce crops it cannot support.

Some of the land in this 40 million acres has been so gutted by erosion that trees will scarcely grow on it. Some of it is so situated that cultivation is out of the question and pasturing is unwise because of the danger of erosion. The banks of streams, drainage ditches, and irrigation ditches, for instance, cannot be farmed but they may amount to several acres of wasted land per mile of stream or ditch. Farmers well know the infertile spots found on almost every farm—the areas of shallow soil underlain by rock or hardpan, the sharp breaks that cannot be farmed without damage to good land downhill, the soggy areas impossible to drain, and the many kinds of sinkholes, rocky outcrops, and rough areas (figs. 42, *A* and *B*).

But there is no need to waste this land. It can yield a number of products that can be used or sold. It can, for instance, be used for raising fur-animals. Furs are badly needed for aviators' clothing and for outfitting troops going to cold climates, in addition to many other purposes. The United States has for some time imported more fur than it has produced. Imports have been reduced as a result of the war, and we shall have to produce more fur in this country. In this the wastelands of agriculture can help enormously.

A stream bank protected from fire and from livestock becomes covered with shrubs and other vegetation in a surprisingly short time. Well-protected stream banks prevent streams from cutting into adjacent good land and provide excellent places in which fur animals can live and increase. In one Iowa county, 4,900 muskrat pelts came from the stream banks on the farms in a single year—$9,800 worth of pelts selling at $2 each. Pond edges, too, can be used in this way.

Good cover, well-distributed on a farm, helps to increase the rabbit supply. On a Tennessee farm, for example, 200 rabbits were taken annually on 114 acres of ordinary hill and bottom land. If cover had been better developed, even more rabbits could have been trapped.

Good cover on all otherwise wasted spots about the farm will also result in more quail and other game. It will bring up the numbers of insect-destroying birds and mammals that help to keep crop pests down. This increase can be obtained by protecting the wildlife land

from fire and grazing or by planting it to shrubs or perennial legumes like sericea lespedeza or heavy grasses.

Careful handling of woodlands will help to increase the numbers of raccoon, grouse, and useful songbirds. Strip cropping usually doubles the number of field birds. Good range management in the West has a similar effect.

Game birds, fur animals, and insect-eating birds usually find enough to eat on the ordinary farm. What they lack—to increase in numbers—is good cover, well distributed. Letting wildlife cover grow on good farm land is wasteful, but it is a good thing to encourage wildlife on land that is not otherwise useful.

GA.-D3-27

FIGURE 43.—Perennial crops offer the most profitable way of using many steep or difficult slopes. Many farmers in the Southeast use legumes like sericea lespedeza to protect critical slopes and furnish good hay, even though, like this farmer, they have to use a hand scythe to cut it.

The farm pond may well be a wildlife refuge and a source of fish for food. In some parts of the country more pounds of fish can be produced per acre of pond than pounds of beef per acre of pasture. In the South, 300 pounds of excellent food—pan-sized bream and bass—can be taken each year by hook and line from a fertilized 1-acre pond. The possibility of adding variety to the menu, to say nothing of the fun of fishing, is well worth attention to the simple management that fish production requires.

BALANCING THE FARM PRODUCTION PROGRAM

Each farmer should plan his part in the war program in accordance with the potentialities of his land and his production facilities (fig. 43). Few farmers can make a flat percentage increase in the production of the several commodities for which there is increased national need.

R3-223

FIGURE 44.—Loading green alfalfa to be put in a silo near Rosedale, Madison County, Ohio. While alfalfa usually supplies cheaper feed when made into hay, cuttings that are rained on and would make poor hay can be saved as silage with very little loss.

In planning individual farm programs, farmers should consider not only what products can be increased but also the means of obtaining this increase. For example, much of the desired production of crops might be obtained by increasing yields per acre through water-conservation methods, increased use of lime, and better cultural practices. Greater production of dairy products does not necessarily call for larger numbers of dairy cattle; in fact, an increase in numbers of dairy cattle is not warranted unless the feed for these cattle is adequate. If pasture is inadequate, or if hay is scanty in amount or poor in quality for the present dairy herd, first attention should be given to improving the forage supply (fig. 44).

In some cases a decrease in numbers may mean an actual increase in production. For example, the Western Range Committee of the Department of Agriculture recently reported that, under proper range management, 11 million animal units on the range could put more beef and mutton on the market and more dollars in the ranchers' pockets than the present 17 million units.

With decreased supplies of new farm machinery and with many men leaving the farms for military service and defense industries, farmers will find further economies necessary in the use of machinery and labor. Greater community cooperation in the exchange of labor and machinery will help. Fortunately, many of the water and soil conservation practices which help to increase yields also decrease the amount of power and labor required. For example, a study conducted in Nebraska showed that 10 percent less time and 17 percent less

tractor fuel were required to produce corn on the contour than were required on noncontour-listed fields. In the production of wheat, 7 percent less time and 10 percent less fuel were required on contoured fields than on noncontoured fields.

Studies made in McLean, St. Clair, and Stephenson Counties in Illinois showed that the labor, power, and machinery costs connected with crop production were lower on contoured farms than on farms where crops were not grown on the contour. These studies showed that the income from the same amount of labor on the farms practicing conservation farming averaged 20 percent larger than the incomes on similar neighboring farms where conservation programs were not in effect. Part of this difference in income was due to larger yields per acre and lower power and labor costs on the farms practicing conservation, and part was due to other savings brought about through the conservation plans. During the next few years the farmer will need to give attention, as never before, to efficient organization and management in order that he may do his part in winning the war through his increased production of needed agricultural products by his wise use of his most important resource—the soil.

CROPS NEEDED FOR LIVESTOCK FEEDING

In peacetime, 70 acres out of each 100 acres of harvested crops, as an average for the whole country, are used for feeding livestock. The crops from the other 30 acres are used directly for human food and for industrial products. Harvested crops supply about half of the feed requirements of livestock, the other half coming from pastures and range.

With the wartime demand for greater output of concentrated and vital foods, such as meat, cheese, and eggs, to help feed our allies and ourselves, much of the increased crop production is needed for feeding livestock.

Since a large part of the crop goals are intended for livestock, it becomes increasingly important to use these feed crops more efficiently in the production of livestock and livestock products. It is a waste of labor, power, material, and soil to strive for the production of greater crop and pasture yields and then to fail to make the best possible use of them in feeding and caring for livestock.

Livestock that fail to fatten or produce milk as they should, or that die from disease before they are ready to market, represent a considerable amount of feed that might have been put to better use. The Nation cannot afford to use labor and land to produce feed crops that are to be wasted by poor methods of feeding and handling livestock (figs. 45, *A* and *B*).

LIVESTOCK AND THE PRESENT EMERGENCY

Since food is a powerful weapon in the war and since production goals call for substantially greater marketing of livestock products and for high production in the years to come, American livestock producers occupy a key position. The basic need for getting this food-production job done quickly, efficiently, and without waste has probably never been greater at any time in our history. Intelligent conservation of natural soil resources is a means toward attaining

livestock goals, because efficient livestock production and effective soil conservation practices go hand in hand.

The new livestock-production knowledge that has been developed in recent years can aid materially in attaining the volume of livestock production needed and help make the operations more profitable to the individual producer. A few of the research results of this nature are cited from Department of Agriculture studies to illustrate the wealth of new production information that is available. Similar helpful information can also be obtained from the State agricultural colleges and experiment stations.

In recent feeding tests with cows that had production records of around 9,300 pounds of milk a year, increases of 16 percent at one station and 23 percent at another resulted from feeding more grain. The United States Department of Agriculture has prepared a circular, More Grain—More Milk, to help farmers work out their feeding problems.

Recent research has developed many striking examples of how mineral deficiencies of the soil directly affect livestock production. Nutritional diseases resulting from insufficient amounts of certain food elements result in poor growth, reproductive failure, and other abnormal conditions. Information developed from experiments of the past few years has now made it possible to control or eliminate many of these diseases. Proper feeding methods applied in areas where a particular nutritional disease is likely to occur will do much to increase the number of calves, pigs, and lambs born alive and healthy and to save and maintain this young stock in thrifty condition so as to yield increased supplies of meat and other products.

Many of the common nutritional diseases are caused by a deficiency of certain minerals and vitamins. Three years' work by the Bureau of Animal Industry in cooperation with the Texas Agricultural Experiment Station and the King Ranch near Falfurrias, Tex., well illustrates the heavy toll taken of the livestock industry by mineral-deficient range and pastures. Three groups of cows grazing a range that was deficient in phosphorus were individually fed definite quantities of phosphorus from various sources. A fourth group received no phosphorus supplement. This past year the calf crop from the group of cows receiving phosphorus was 77 percent as compared with 41 percent for the group that was fed no phosphorus supplement. This increase in calf crop resulted in 378 pounds of weaned calf per cow for supplement-fed groups compared with 176 pounds for the cows not so fed. Calves from the cows fed phosphorus supplement weighed approximately 65 pounds more at weaning and about 100 pounds more at 1 year of age than did those from the other cows. During two consecutive years, 76 percent of the supplement-fed cows produced a calf each year, as compared with 23 percent of the other cows. The annual cost of the phosphorus supplement averaged about $2.60 per cow.

Research has shown conclusively that adequate amounts of the proper minerals and vitamins in the rations for the various classes of farm animals can prevent such ailments as night blindness, creeps, goiter, rickets, and anemia. Fortunately, there is considerable information now available on how to prevent these nutritional deficiency diseases in the various classes of farm livestock.

MINN.–836; MINN.–835

FIGURE 45.—*A*, These hogs make poor returns on the corn they are fed, because their feed lot is infested with worms and weeds. Contrast with *B*, where hogs are doing an efficient job of turning corn and alfalfa into pork needed to win the war. The pasture is clean because no hogs were on it the previous year. Note that the hogs have plenty of shade.

The results of studies on the selection and reproduction of range ewes at the United States Western Sheep Breeding Laboratory have proved the advantage of doing most of the year's culling on the yearling ewes. Ewes yielding less than 9 pounds of unscoured wool as yearlings produced fleeces averaging 10.4 pounds and lambs averaging 10 pounds at birth. Ewes yielding 9 pounds or more of unscoured wool as yearlings produced during their lifetime fleeces averaging 11.2 pounds annually and lambs averaging 11 pounds at birth. Since breeding ewes can safely be selected as yearlings, greater production and real economy

I0291-A

FIGURE 46.—Parts of an electric pig brooder in the corner of a pen in a farrowing house.

is permitted by the earlier elimination of the star boarders from the flock.

Now, when the war program is calling for an increase in pork, proper attention to breeding, care of young pigs, feeding, management, and control of sanitary conditions to lessen death losses of pigs during the growing and fattening periods are important. Today every pig counts.

Experiments at the Bureau of Animal Industry's Beltsville Station have proved that abundant protein-rich feeds in the early life of the pig stimulate growth. In these tests 3-week old pigs were given free access for a period of 11 weeks to a creep containing such protein supplements as skim milk, tankage, soybean-oil meal, or peanut meal, in addition to a standard ration for the sows and pigs. Thereafter all pigs received the same ration to market weight. The added protein in the early period of the pig's life produced greater gain on considerably less feed requirements, and the pigs generally reached market weight at considerably earlier ages than those not supplied with the supplemental protein feed.

The application of feeding tests to identify animals of high pork-producing efficiency is well illustrated in the wide differences that have been found at the Beltsville station among the offspring of breeding animals not materially different in outward appearance. The results obtained with two such litters of pigs fed out from weaning to market weight of approximately 225 pounds under identical conditions showed that one litter averaged but 1.02 pounds daily

gain per pig, with 397 pounds of feed required per hundred pounds of gain, while the other litter had an average daily gain of 1.49 pounds per pig on a feed requirement of slightly less than 303 pounds of feed per one hundred pounds gained. And yet, the sire and dam of the first litter, on appearance alone, would have been considered as satisfactory for breeding animals as those of the second litter.

At the Beltsville station the use of electric pig hovers has proved effective in saving about 5 percent more spring pigs. Ordinary 150- or 200-watt electric lights were used in simply constructed hovers fitted into a corner of each farrowing pen. The additional warmth provided further benefits for the pigs which had had access to the electric hovers for a week or two after they were farrowed as they averaged nearly 1½ pounds heavier at weaning age of 8 weeks. Detailed plans for making a simple, easily constructed electric pig hover may be obtained from the Rural Electrification Administration of the Department of Agriculture (figs. 46 and 47).

10465-A

FIGURE 47.—Young pigs enjoying the heat from the electric pig brooder spend most of their time under the brooder, with less danger of being mashed by the sow. The sows also are attracted by the heat and lie close to the brooder.

A War Board representing all Federal Government agencies has been established in each State and county to help in carrying out the farm War Program. Farmers who are interested in obtaining additional information regarding practices which will help to increase the production of agricultural products needed for winning the war are urged to get in touch with their State college of agriculture or their County War Board or to write to the United States Department of Agriculture, Washington, D. C.

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